$$x = \frac{a}{2}\sin(\theta)$$

$$\text{zeroes} \qquad x = \frac{1}{2}\lambda = \frac{a}{2}\sin(\theta)$$

$$\sin(\theta) = \frac{\lambda}{a}$$

$$\sin(\theta) \simeq \frac{y}{L} \qquad \Rightarrow \qquad y = 1\,\frac{L\lambda}{a}$$

$$x = \frac{a}{4}\sin(\theta)$$

$$\sin(\theta) = \frac{2\lambda}{a}$$

$$\sin(\theta) \simeq \frac{y}{L} \qquad \Rightarrow \qquad y = 2\,\frac{L\lambda}{a}$$

$$y = M\,\frac{L\lambda}{a} \quad , \qquad M = 1, 2, 3, ...$$

$$x = dz\sin(\theta)$$

$$\frac{x}{\lambda} = \frac{dz}{\lambda}\,\sin(\theta)$$

$$\frac{2\pi x}{\lambda} = \frac{2\pi dz}{\lambda}\,\sin(\theta)$$

$$A_m = \frac{A}{a/dz} = A\left(\frac{dz}{a}\right)$$

$$y_1 = A_m\,\frac{1}{r_1}\sin(kr_1 - \omega t)$$

$$y_2 = A_m\,\frac{1}{r_2}\sin(kr_2 - \omega t)$$

$$y_1 = \frac{A_m}{r_{\text{avg}}}\sin(kr_1 - \omega t)$$

$$y_2 = \frac{A_m}{r_{\text{avg}}}\sin(kr_2 - \omega t)$$

$$\text{phase offset} = \frac{2\pi\sin(\theta)}{\lambda}\,dz$$

$$y_1 = \frac{A_m}{r_{\rm avg}}\,\sin\left(0 - \omega t\right)$$

$$y_2 = \frac{A_m}{r_{\rm avg}}\,\sin\left(\frac{2\pi\sin(\theta)}{\lambda}z - \omega t\right)$$

$$\text{sum of all waves} = \int_{z=0}^{z=a} \frac{A_m}{r_{\rm avg}}\,\sin\left(\frac{2\pi\sin(\theta)}{\lambda}z - \omega t\right)$$

$$\text{sum of all waves} = \int_{z=0}^{z=a} \left(\frac{A\,dz}{a}\right)\,\frac{1}{r_{\rm avg}}\,\sin\left(\frac{2\pi\sin(\theta)}{\lambda}z - \omega t\right)$$

$$\text{sum of all waves} = \frac{A}{r_{\rm avg}}\int_{z=0}^{z=a} \frac{1}{a}\,\sin\left(\frac{2\pi\sin(\theta)}{\lambda}z - \omega t\right)dz$$

$$\text{sum} = \frac{A}{r_{\rm avg}}\left\{-\frac{1}{a}\frac{\lambda}{2\pi\sin(\theta)}\,\cos\left(\frac{2\pi\sin(\theta)}{\lambda}a - \omega t\right) + \frac{1}{a}\frac{\lambda}{2\pi\sin(\theta)}\,\cos\left(0 - \omega t\right)\right\}$$

$$\beta = \frac{2\pi\sin(\theta)a}{\lambda}$$

$$\text{sum} = \frac{A}{r_{\rm avg}}\left\{-\frac{1}{\beta}\,\cos\left(\beta - \omega t\right) + \frac{1}{\beta}\,\cos\left(0 - \omega t\right)\right\}$$

$$\cos(P) - \cos(Q) = -2\sin\left(\frac{P+Q}{2}\right)\sin\left(\frac{P-Q}{2}\right)$$

$$\text{sum} = \frac{A}{r_{\rm avg}}\left\{\frac{2}{\beta}\,\sin\left(\frac{\beta - 2\omega t}{2}\right)\,\sin\left(\frac{\beta}{2}\right)\right\}$$

$$\text{intensity} = \text{amplitude}^2 = \frac{A^2}{r_{\rm avg}^2}\left\{\left[\sin\left(\frac{\beta - 2\omega t}{2}\right)\right]^2\left(\frac{\sin(\frac{\beta}{2})}{\frac{\beta}{2}}\right)^2\right\}$$

$$\text{time} - \text{averaged intensity} = \frac{A^2}{r_{\rm avg}^2}\left(\frac{\sin(\frac{\beta}{2})}{\frac{\beta}{2}}\right)^2$$

$$\sin(\theta) \simeq \frac{y}{L}$$

$$\beta = \frac{2\pi a}{\lambda}\,\frac{y}{L}$$

$$y_{\rm sum} \quad = \quad A\,\frac{1}{r_1}\sin(kr_1 - \omega t) \;+\; A\,\frac{1}{r_2}\sin(kr_2 - \omega t) \;+\; A\,\frac{1}{r_3}\sin(kr_3 - \omega t)$$

$$\text{neighbor phase offset } \phi \quad = \quad \frac{2\pi d\sin(\theta)}{\lambda} \qquad\qquad \text{(radians)}$$

$$y_{\rm sum} \quad = \quad \left(\frac{A}{r_{\rm avg}}\right)\,\Big[\sin(0 - \omega t) \;+\; \sin(\phi - \omega t) \;+\; \sin(2\phi - \omega t)\Big]$$

$$y_{\rm sum} \quad = \quad \left(\frac{A}{r_{\rm avg}}\right)\,2\sin\left(\frac{2\phi - 2\omega t}{2}\right)\cos\left(\frac{2\phi}{2}\right) \;+\; \left(\frac{A}{r_{\rm avg}}\right)\,\sin(\phi - \omega t)$$

$$y_{\rm sum} \quad = \quad \left(\frac{A}{r_{\rm avg}}\right)\,\Big[2\cos(\phi) + 1\Big]\;\sin(\phi - \omega t)$$

$$\text{intensity} \;=\; (\text{amplitude})^2 \quad = \quad \left(\frac{A}{r_{\rm avg}}\right)^2\,\Big[2\cos(\phi) + 1\Big]^2 \sin(\phi - \omega t)^2$$

$$\text{time} - \text{averaged intensity} \quad = \quad \frac{1}{2}\left(\frac{A}{r_{\rm avg}}\right)^2\,\Big[2\cos(\phi) + 1\Big]^2$$

$$\text{sum of N slits} \quad \propto \quad A\left[\frac{\sin(N\phi/2)}{\sin(\phi/2)}\right]$$

$$\text{intensity of N slits} \quad \propto \quad A^2\left[\frac{\sin(N\phi/2)}{\sin(\phi/2)}\right]^2$$

$$d\sin(\theta) \quad = \quad \lambda$$

$$d\sin(\theta) \quad = \quad \lambda \;+\; \epsilon$$

$$10\,\Big[d\sin(\theta)\Big] \quad = \quad 10\lambda \;+\; 10\epsilon$$

$$y_{\rm sum} \quad = \quad \left(\frac{A}{r_{\rm avg}}\right)\,\Big[\sin(0 - \omega t) \;+\; \sin(\phi - \omega t)\Big]$$

$$y_{\rm sum} \quad = \quad \left(\frac{A}{r_{\rm avg}}\right)\,\Big[\sin(0 - \omega t) \;+\; \sin(\phi - \omega t) \;+\; \sin(2\phi - \omega t) \;+\; \sin(3\phi - \omega t)\Big]$$

$$y_{\rm sum} \quad = \quad A\left[\frac{\sin(N\phi/2)}{\sin(\phi/2)}\right]$$